Topic: Product rule, two functions

Question: Find the derivative.

$$y = \left(x^2 + 2\right)\left(x^3 + 1\right)$$

Answer choices:

A $y' = 5x^3 + 6x + 2$

B $y' = x^4 + 12x^2 + 2x$

C $y' = 5x^4 + 6x^2 + 2x$

D $y' = 5x^4 - 6x^2 + 2x$

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Solution: C

Remember that the product rule is

$$\frac{d}{dx}\left[f(x)\cdot g(x)\right]=f'(x)g(x)+f(x)g'(x)$$

If we say that $f(x)=x^2+2$ and that $g(x)=x^3+1$, then we get

$$y'=(2x)\left(x^3+1\right)+\left(x^2+2\right)\left(3x^2\right)$$

$$y'=2x^4+2x+3x^4+6x^2$$

$$y'=5x^4+6x^2+2x$$

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Topic: Product rule, two functions

Question: Find the derivative.

$$y = \left(3x^2 + 2x\right)\left(x^4 - 3x + 1\right)$$

Answer choices:

A $y' = 18x^4 + 10x^3 - 27x^2 - 6x + 2$

B $y' = 10x^5 + 27x^4 - 27x^2 - 6x + 2$

C $y' = 18x^5 + 10x^4 + 27x^2 - 6x + 2$

D $y' = 18x^5 + 10x^4 - 27x^2 - 6x + 2$

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Solution: D

Product rule tells us that the derivative of our function will be

$$y' = \left(3x^2 + 2x\right)\frac{d}{dx}\left(x^4 - 3x + 1\right) + \left(x^4 - 3x + 1\right)\frac{d}{dx}\left(3x^2 + 2x\right)$$

$$y' = \left(3x^2 + 2x\right)\left(4x^3 - 3\right) + \left(x^4 - 3x + 1\right)\left(6x + 2\right)$$

$$y' = \left(12x^5 - 9x^2 + 8x^4 - 6x\right) + \left(6x^5 + 2x^4 - 18x^2 - 6x + 6x + 2\right)$$

$$y' = 12x^5 - 9x^2 + 8x^4 - 6x + 6x^5 + 2x^4 - 18x^2 - 6x + 6x + 2$$

$$y' = 18x^5 + 10x^4 - 27x^2 - 6x + 2$$

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Topic: Product rule, two functions

Question: Take the derivative.

$$h(x) = \left(3x^2 - 7\right)\left(x^2 - 4x + 3\right)$$

Answer choices:

A $6x^3 - 36x^2 + 4x + 28$

B $12x^3 - 36x^2 + 32x + 28$

C $12x^3 - 12x^2 + 4x + 28$

D $12x^3 - 36x^2 + 4x + 28$

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Solution: D

To differentiate two functions with the product rule, use the product rule formula

$$\frac{d}{dx}f(x)g(x) = f'(x)g(x) + f(x)g'(x)$$

Applying the product rule to the given function

$$h(x) = \left(3x^2 - 7\right)\left(x^2 - 4x + 3\right)$$

gives

$$h'(x) = \left[(6x)\left(x^2 - 4x + 3\right)\right] + \left[\left(3x^2 - 7\right)(2x - 4)\right]$$

$$h'(x) = 6x^3 - 24x^2 + 18x + 6x^3 - 12x^2 - 14x + 28$$

$$h'(x) = 12x^3 - 36x^2 + 4x + 28$$

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